BIOLOGICAL TREATMENT of RUNOFF

Sarah A. White, Ph.D.

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SCRI - CLEAN WATER³
REDUCE, REMEDIATE, RECYCLE
Water challenges & concerns

- Contaminants?
- Availability?
- Salts
- Pesticides
- Pathogens
Irrigation timing?

Plant diseases?

Cultural practices?

How much have I lost?

$ and opportunity cost
Biological treatment technologies

- Sediment basins
- Filter strips
  - Vegetative buffers
  - Vegetative waterways
- Constructed water (wetland) treatment basins (CWs)
  - Surface-flow
  - Subsurface-flow
- Floating wetlands
Sediment/erosion control

- Develop an erosion / sediment control plant
- Prevent sediment from leaving the nursery
  - stabilize critical areas – grass (time of year) or mulch
  - erosion control blankets/netting
Sediment basins
Bioretention basin
Biological treatment technologies

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- Filter strips
  - Vegetative buffers
  - Vegetative waterways
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  - Surface-flow
  - Subsurface-flow
- Floating wetlands
Filter strips

Bands of vegetation used between production areas & retention ponds

- Slow runoff
- Trap:
  - Sediment
  - Fertilizer
  - pesticides
  - (potentially) pathogens

Before they enter surface water
Biological treatment technologies

- Sediment basins
- Filter strips
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- Floating wetlands
Constructed water treatment basins (CWs)

- Low maintenance
- Specific contaminants
- Recycle or release water
Wetland (water basin) functions

- Soils provide habitat for microbes
- Microbes process
  - nutrients
  - organic contaminants
- Vegetation slows water
- Plant uptake/absorption
  - nutrients
  - trace metals
  - other compounds
Surface-flow CWS
Case Study: Monrovia® Cairo, GA
Case Study: CW1 – 14 years

- 120 acres of production drain to wetland
- 9.3 acre wetland
- Two-stage
  - deep cell
  - shallow cell
How well do surface-flow CWs clean nursery runoff?
Nitrogen results

![Graph showing nitrogen removal and water temperature over time.](image-url)
Phosphorus results

Removal efficacy (%) vs Phosphorus (ppm)

Assimilation
Generation / Export
Surface-flow CWS

- Most efficient with high to moderate runoff volumes
- Efficient nitrogen removal
- Phosphorus not consistently treated
- Pesticide removal 50-98%
  - organochlorine
  - organophosphate
  - pyrethroid
Subsurface flow CWS
Subsurface flow CWS
Subsurface flow CWS

- Reduce ammoniacal N emissions
- Efficient nitrogen & phosphorus removal
  - sediment will become P saturated
- Pesticide removal depends upon pesticide class
Floating treatment wetlands (FTW)

Image source: Floating islands international
Floating treatment wetlands (FTWs)
Floating wetland: functions

- Large root surface area for microbe habitat
- Particulate filtration
- Nutrient removal
- Provide “edge” shelter & general wildlife habitat
N & P remediation

**Canna**

- **Total Nitrogen (NO, NO2, NO3, NH3)**
- **Total Phosphorus (P, PO4)**

Graphs showing nitrogen and phosphorus levels from April to September, with different treatments labeled as A100.10, A100.20, A50.10, and Influent.
## Remediation efficiencies

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Filter strip</th>
<th>FTW</th>
<th>Surface flow</th>
<th>Subsurface flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSS</td>
<td>41 -100</td>
<td>-</td>
<td>71 ± 35</td>
<td>83</td>
</tr>
<tr>
<td>TP</td>
<td>27 - 96</td>
<td>44 ± 75</td>
<td>9 - 54</td>
<td>33 - 90</td>
</tr>
<tr>
<td>TN</td>
<td>48 - 85</td>
<td>58 - 84</td>
<td>50 - 90</td>
<td>19 - 90</td>
</tr>
<tr>
<td>Herbicides*</td>
<td>30 - 91</td>
<td>?</td>
<td>24 - 100</td>
<td>24 – 97</td>
</tr>
</tbody>
</table>

TSS = total suspended solids | TP = total phosphorus | TN = total nitrogen

* Removal efficacy vary by compound, some not removed
Conclusions

• Each technology discussed has specific benefits and limitations

• Technology applied for remediation depends upon site-specific considerations
  • operation size
  • treatment volume
  • contaminants of concern
Contact Information

Sarah A. White, Ph.D.
Department of Plant & Environmental Sciences
Clemson University
E-143 Poole Agricultural Center
Clemson, SC 29634-0319
865.656.7433
swhite4@clemson.edu

Resources:
*Constructed Wetlands: A How to Guide for Nurseries*
Available for free: [https://goo.gl/KQyGDU](https://goo.gl/KQyGDU)

Cleanwater3.org – treatment technology information